Subject Index to Volume 78

A

Acetylcholine
angiotensin-induced drinking and, 638–639
calcium signaling in glial cells, 119
Actin filaments, in cell volume regulation, 253–254
Action potentials
olfactory neurons, 434–436
visceral smooth muscle cells, 817–822
Adenosine, in short-term myocardial hibernation, 1066–1067
Adenosine 3′,5′-cyclic monophosphate (cAMP)
effects of melatonin signal transduction, 701–702
glomerular mesangial relaxation, 731–732
signaling in olfactory cells, 442–446
Adenosine triphosphatase, Na^+-K^+, signal transduction of dopamine receptors, 197
Adenosine 5′-triphosphate-sensitive potassium channel. *See* Potassium channels, K_{ATP}
Adenylyl cyclase, signal transduction of dopamine receptors, 195
Adipocyte differentiation, 783–801
clonal expansion, 788–789
early changes in gene expression, 789–790
extracellular matrix components and, 797–798
factors modulating, 790–798
growth arrest, 787–788
hormones and signal transduction pathways regulating, 791–795
in vitro models, 785–787
late events and terminal differentiation, 790
origin of adipocytes, 784–785
Pref-1, an EGF repeat-containing inhibitor, 795–797
process of, 787–790
transcription factors for, 798–801
bHLH family, 800–801
C/EBP family, 799–800
PPAR family, 799
Adipose tissue
adipocyte differentiation, 783–801
brown, nonshivering thermogenesis and aging, 347–352
origin of, 784–785
as secretory organ, 784
Adrenal cortex, dopamine receptors in, 207
Adrenal insufficiency, sodium appetite of, renin-dependent drinking, 660–661
***β*-Adrenergic agents, hyperreninemia, drinking behavior and, 649–650**
Adrenomedullin, angiotensin-induced drinking and, 646–647
Age/aging
cerebral circulation and, 71–72
cold-induced thermoregulation, 341–354
animal research, 342
cold perception, 342–343
heat loss, 343–345
heat production, 345–352
human investigation, 342
overview, 341–343
rate of aging and, 352–353
cold perception, 342–343
definition of aging, 340
evolutionary theories, oxidants and, 554–555
free radical theory, 547–572. *See also* Free radical theory
heat loss, 343–345
insulative properties of body fat, 344–345
vasoconstriction, 343–344
heat production, 345–352
brown adipose tissue nonshivering thermogenesis, 347–352
skeletal muscle shivering thermogenesis, 345–347
mitochondrial theories, oxidants and, 556
research designs, 340–341
somatic mutation theory, oxidants and, 555–556
Airway
mutual relationship between nitric oxide and vasoactive intestinal polypeptide, 836–838
smooth muscle cells
heterogeneous distribution of receptors, especially on nitrergic receptors, 835
muscarinic receptors, 830
nerve plexuses, nerve terminals, varicosities, and cotransmitters, 825
Aldosterone, production, dopamine receptors and, 206–207
Alzheimer's disease, 569
transgenic animal model, 1154–1155
Amino acids
anionic, transport systems, 973
cationic, transport, 487–539, 972–973. *See also* Cationic amino acid transporters
epithelial, 528–535
genetic disorders, 533–535
nitrogen metabolism, 527
nutrition, 527–528
physiology, 526–538
protein synthesis and growth, 527
regulation, 536–538
cell volume regulation, 252
excitatory, angiotensin-induced drinking and, 640
gut microbe-produced, absorption, 417
inhibitory, angiotensin-induced drinking and, 640
plasma membrane transport, 969–1039. *See also* Amino acid transporters
inherited disorders, 1032–1038
systems, 970–973
zwitterionic, transport systems, 970–972
Amino acid transporters, 969–1039
cationic, 976–985. *See also* Cationic amino acid transporters

molecular structure, 975–1032
putative subunits of Na^+-independent cationic and zwitterionic amino acid transporters, 1022–1032
physiological role of rBAT and 4F2hc, 1030–1032
protein structure, 1028–1030
tissue expression, 1023–1024
transport properties, 1024–1028
strategies to identify, 973–975
superfamily of Na^+- and Cl^--dependent neurotransmitter transporters, 985–1003
mechanism of transport and uncoupled ion fluxes, 991–996
physiological role, 1001–1003
protein structure, 996–997
structure-function relationships, 997–1001
tissue expression, 986–989
transport characteristics, 989–991
superfamily of Na^+-dependent transporters for anionic and zwitterionic amino acids, 1003–1022
ligand-gated Cl^- channel activity, 1013–1016
mechanism of transport, 1012–1013
physiological role of glutamate superfamily transporters, 1020–1022
protein structure, 1016–1018
stoichiometry, 1011–1012
structure-function relationship, 1018–1020
tissue expression, 1005–1008
transport properties, 1008–1011
systems in plasma membrane of mammalian cells, 970–972
γ-Aminobutyric acid, calcium signaling in glial cells, 118–119
Ammonia, gut microbe-produced, absorption, 417
Amphibians
melanophores, melatonin transduction, 695
nutrition, diet, habitat, and digestive system characteristics, 395–396
Amygdala, angiotensin-induced drinking and, 627–628
Amyotrophic lateral sclerosis, transgenic animal model, 1153–1154
Anaphylatoxins, leukocyte chemotaxis, 950
Androgen(s), in sexual differentiation, 17–18
Androgen receptor, defects, testicular feminization, 18–19
Angiotensin
analogs, and drinking behavior, 611–620
in drinking behavior, 585–587, 593. *See also* Drinking behavior
central nervous system and. *See* Brain
effects of angiotensin analogs and antagonists, 611–620
(1–7) heptapeptide, in drinking behavior, 617–619
(2–8) heptapeptide, in drinking behavior, 619
(3–8) hexapeptide, in drinking behavior, 619
peptides formed from precursors in the brain, 630–637
components and distribution, 630–631
in drinking behavior, 633–636
possible functions, 631–633
sodium intake, 605–609
intracranial angiotensin administration, 606–607
strain, sex differences and sex hormones, 608–609
systemic angiotensin administration, 607–608
structure-activity, and drinking behavior, 611
in thirst and sodium appetite, 583–670
angiotensin-induced sodium appetite, 605–611
angiotensin-induced thirst, 593–605
causes of renin-dependent drinking, 658–667
central nervous system in, 620–630
drug-induced hyperreninemia and drinking, 649–658
effects of angiotensin analogs and antagonists on drinking, 611–620
hypovolemic thirst and sodium appetite, 589–593
neurotransmitters and angiotensin-induced drinking, 637–639
role of angiotensin peptides formed from precursors in brain, 630–637
water intake in rat, 593–600
intracranial angiotensin administration, 594–595
ontogeny of angiotensin-induced drinking, 600
sex differences and sex hormones, 598–600
strain differences, 597–598
systemic angiotensin administration, 595–597
Angiotensin II
calcium signaling in glial cells, 123
precursors, in drinking behavior, 617
Angiotensin III, in drinking behavior, 619
Angiotensin IV, in drinking behavior, 619
Angiotensin analogs, and drinking behavior, 611–620
Angiotensin antagonists, and drinking behavior, 611–616
angiotensin analog antagonists, 612–613
angiotensin antibodies, 611–612
antisense oligonucleotides, 616
receptor subtypes and selective antagonists, 613–616
Angiotensin-converting enzyme (ACE) inhibitors, hyperreninemia, drinking behavior and, 651–655
Antibodies, angiotensin, 611–612
Antioxidant(s)
dietary
nutritional epidemiology, 569–570
supplementation, 563–564
pharmacological, supplementation, 564
Antioxidant defenses, 553–554
age-associated trends, 560
maximum life-span potential, 561–562
signal transduction, 571–572
Antisense oligonucleotide, angiotensin antagonist, in drinking behavior, 616
Apoptosis
cell volume regulation and, 272
cytoskeleton and, 772–773
oxidants and, 571
Arachidonic acid
calcium signaling in glial cells, 123
signal transduction of dopamine receptors, 197
Ascidian embryo
cell lineage, 310–312

ion channels and neural induction, 308–309. *See also* Neuronal differentiation
neural commitment and changes in expression of ion channels, 320–322
TuNa I channels—neuron-specific markers expressed after inductive differentiation, 321–322
two-cell induction system constructed from, 320–321
Astrocytes
glutamate-induced calcium signaling, 111–114
purine- and pyrimidine-induced calcium signaling, 115–116
voltage-gated Ca channels and depolarization-induced signals, 106–107
Atherosclerosis, cerebral circulation and, 70–71
Autophagy
hepatocyte, microtubule-dependent vesicle transport and, 1117–1118
peroxisome degradation, 182–183
Autoregulation, cerebral circulation, 55
Autosomal dominant polycystic kidney disease, 1165–1186
Autosomes, in sex determination and differentiation, 15–21

B

Behavior, transgenic animal study, 1146–1152
Benzodiazepine receptors, calcium signaling in glial cells, 124
Betaine, cell volume regulation, 252
Bile salts, hepatic transport and secretion, microtubule-dependent vesicle transport, 1113–1115
Birds
angiotensin-induced water intake, 603
nutrition, diet, habitat, and digestive system characteristics, 397–398
Blood flow, cerebral. *See* Cerebral circulation
Blood vessels
dopamine receptors, 205–206
smooth muscle cells, purinoceptors, 832
Body fat, insulative properties, biological aging and, 344–345
Bombesin-like peptides, angiotensin-induced drinking and, 640–642
Bradykinin, calcium signaling in glial cells, 120
Brain
angiotensin-induced drinking and, 620–630
amygdala, 627–628
anteroventral third ventricular region and lamina terminalis, 624–625
brain stem and area postrema, 628–629
c-*fos* expression, 621–622
circumventricular organs, 623–624
organum vasculosum of lamina terminalis, 625–626
subfornical region, 626–627
angiotensin peptide precursors, drinking behavior, 630–637
dopamine receptors in, 198–204
clinical and pharmacological implications of multiple receptors, 204
distribution, 198–200
function, 200–201
regulation of gene expression, 201–203
transgenic animal studies, 203–204
Brattleboro rat, diabetes insipidus, renin-dependent drinking, 665–666
Brown adipose tissue (BAT). *See* Thermogenesis

C

***Caenorhabditis elegans*, genetics, free radical theory of aging, 565–566**
Calcitonin, in calcium homeostasis, 1201–1202
Calcitonin gene-related peptide, neural control of visceral smooth muscle cell membrane activities, 838–839
Calcium
in cell volume regulation, 255
cytosolic free calcium and leukocyte chemotaxis, 949–961
glial. *See* Gial cells
intracellular
cytoskeleton and, 768
effects of melatonin signal transduction, 703–705
increase, hypothetical mechanism of melatonin inhibition, 705–708
visceral smooth muscle cells, 873–884
in olfactory transduction, 450–452
Calcium channels
development, 325–326
egg-type, 317–318
glomerular mesangial plasmalemmal membrane, 729
in oocytes, 315–317
signal transduction of dopamine receptors, 195–196
in visceral smooth muscle cells, 848–852
voltage-gated, depolarization-induced calcium signals in glial cells, 106–109
Calcium currents, voltage-gated, action potential generation in olfactory neurons, 435
Calcium homeostasis
calcitonin in, 1201–1202
development of homeostatic mechanisms, 1200
intestinal calcium and phosphorus absorption, 1202
parathyroid gland and hormone in, 1200–1201
vitamin D in, 1200–1203
bone calcium mobilization, 1202–1203
Calcium pump, regulation, sarcoplasmic reticulum, phospholamban and, 930–937
Calcium transient, in short-term myocardial hibernation, 1067–1068
Carbohydrate metabolism
shivering thermogenesis and aging, 346–347
somatotropin and, 754–755

Carbon monoxide
cerebral circulation regulation, 62
in olfactory neurons, 452
Cardiac muscle
function, phospholamban in, 921–940
K_{ATP} channels, 235–236
striated, lattice effects, 375–377
Catecholamine(s)
angiotensin-induced drinking and, 639–640
release, dopamine receptors in, 207–208
Catecholamine receptors, in visceral smooth muscle cells, 828–829
Cation channels
G protein-coupled, visceral smooth muscle cells, 859–869
nonselective
cytosolic Ca^{2+}-activated, visceral smooth muscle cells, 869–870
glomerular mesangial plasmalemmal membrane, 728–729
visceral smooth muscle cells, 853
unclassified, visceral smooth muscle cells, 870
Cationic amino acid transporters, 487–539
broad-scope amino acid-specific transporters (BAT family), 499–503
4F2hc, 503–504
rBAT and D_2, 499–503
cationic amino acid-specific transporters (CAT family), 493–499
mCAT-1, 493–495
mCAT-2, 495–499
rAT-3, 499
functional properties, 512–526
identification of cDNA sequences encoding, 493–504
broad-scope amino acid-specific transporters (BAT family), 499–503
cationic amino acid-specific transporters (CAT family), 493–499
identification of distinct transport activities, 488–493
in intestines, 529–531
in kidney, 531–532
kinetic theory and methodology, 504–512
molecular structure, 976–985
physiological role, 983–985
physiology of transport, 526–535
epithelial transport, 528–535
nutrition, 527–528
regulation, 536–538
in placenta, 532–533
protein structure, 982
specificity and mechanism, 504–526
kinetic theory and methodology, 504–512
structure-function relationships, 982–983
system $b^{0,+}$, 490–491
functional properties, 518–521
system $B^{0,+}$, 490
functional properties, 517–518
system y^+, 488–490
functional properties, 512–517
system y^+L, 491–493
functional properties, 521–526
tissue expression, 977–980
transport properties, 980–981
Caudal artery, melatonin signal transduction, 699
Cell death, cell volume regulation and, 272
Cell migration, cell volume regulation and, 269–270
Cell proliferation, cell volume regulation and, 271–272
Cell volume regulation, 247–273
cell death and, 272
cell proliferation and, 271–272
challenges of cell volume constancy, 259–264
energy depletion, 261
extracellular ion composition, 260–261
extracellular osmolarity, 259–260
ion transport altered by hormones and transmitters, 261
metabolism, 261–263
substrate transport, 261
epithelial transport and, 264–265
erythrocyte function and, 264
excitability and contraction and, 268–269
hormone and transmitter release and, 267–268
intracellular signaling, 252–259
calcium in, 255
cell membrane potential, 254–255
cell membrane stretch, 254
chloride in, 257
cytoskeleton in, 253–254
cytosolic pH, 255
eicosanoids in, 257–258
gene expression, 259
G proteins in, 255–256
macromolecular crowding, 253
magnesium in, 257
pH in acidic cellular compartments, 258
protein phosphorylation in, 256–257
metabolic regulation and, 266–267
migration and, 269–270
pathogen-host interaction and, 270–271
receptor recycling and, 267
regulatory mechanisms, 248–252
amino acids, 252
betaine, 252
further metabolic pathways, 252
glycerophosphorylcholine, 251
inositol, 252
ions, 249
osmolytes, 251–252
role in cell functions, 264–273
sorbitol, 251
taurine, 252
volume regulatory ion transport, 249–251
Cerebral circulation, 53–75
autoregulation, 55

cerebral blood vessel characteristics, 54–55
flow-mediated vasodilatation, 55
humoral stimuli, 54
hypercapnia and hypoxia and, 55
hypercholesterolemia and atherosclerosis and, 70–71
in hypertension, 68–70
meningitis and, 73–74
metabolic stimuli, 54–55
neural stimuli, 54
regulation
cerebral blood vessel characteristics, 54–55
endothelium-derived vasoactive factors, 55–62
inducible nitric oxide synthase in, 62–64
potassium channels in, 64–68
subarachnoid hemorrhage and, 72–73
endothelin in, 72
endothelium-dependent relaxation in, 72
potassium channels in, 73

c-*fos*, expression, after angiotensin-induced drinking, 621–622

Chemoattractants, 950–952
anaphylatoxins, 950
chemokines, 950
cross-signaling, 952
platelet-activating factor, 951
substance P, 951
substances released by invading organisms, 950–951

Chemokines, leukocyte chemotaxis, 950

Chemotaxis
calcium and cytoskeleton in, 954–960
alteration of polarity and termination of chemotaxis, 959–960
calcium signaling, 952–954
initiation of chemotaxis, 955–958
maintenance of polarity and motion, 959
morphological changes in, 952–954
prechemotaxis events and adhesive interactions, 955
structural polarity and forward motion, 958–959
calcium signaling, 952–954
calcium-binding proteins, 953–954
cytosolic second messengers: inositol 1,4,5-trisphosphate and calcium, 953
intracellular effectors, 954
lipid messengers, 954
receptor-to-cytosol signaling, 953
chemoattractants, 950–952
control, cytosolic free calcium and cytoskeleton in, 949–961
initiation of, 955–958
calcium signaling, 955–956
shape change, 956–958
morphological changes in, 952–954

Chloride, in cell volume regulation, 257

Chloride channels
egg-type, 318
glomerular mesangial plasmalemmal membrane, 728–729
in visceral smooth muscle cells, 852–853

Chloride current, calcium-activated, cAMP-mediated signaling in olfactory cells, 445–446

Circadian rhythm, synchronization, melatonin in, 690

Circulatory shock, renin-dependent drinking, 661

Cold exposure, thermoregulation. *See* Thermoregulation

Cold perception, aging and, 342–343

Complement fragments, calcium signaling in glial cells, 122

Contraction
glomerular mesangial cells, 730–731
myocardial, hibernating myocardium, 1055–1057
striated muscle, A-band lattice effects, 367–369
visceral smooth muscle cells, calcium sensitization, 884–889

Coronary reserve, in myocardial hibernation
chronic, 1074
short-term, 1064

Cortical dynamics, adult, 467–481

Cross-signaling, leukocyte chemotaxis, 952

Cystinuria, 533–534, 1034–1035

Cysts
hepatic, in polycystic kidney disease, 1183
renal. *See* Polycystic kidney disease

Cytoskeleton
apoptosis and, 772–773
cell signaling, 763–775
in cell volume regulation, 253–254
enzymatic activities, 764–768
glycolytic enzymes, 764–765
GTPases, 767–768
lipid kinases and phospholipases, 766–767
protein kinases, 765–766
intracellular calcium and, 768
ion channels and transporters, 768–771
in leukocyte chemotaxis, 949–961. *See also* Chemotaxis
sensing and transmitting mechanical stresses, 771–772
in signaling to nucleus, 773–774

Cytosol, pH, in cell volume regulation, 255

D

Degenerative diseases
inherited, 569
sporadic, 569

Detoxification, microbial, gastrointestinal tract, 418

Diabetes insipidus, Brattleboro rat, renin-dependent drinking, 665–666

Diabetes mellitus
cerebral circulation and, 71
mesangial cells in diabetic models, 734–736
ion channels in, 736
mesangial tone, 735
renin-dependent drinking, 666–667

Dicarboxylic aminoaciduria, 1038

1α,25-Dihydroxyvitamin D_3. *See* Vitamin D

Dopamine receptors, 189–212
in blood vessels, 205–206
in brain, 198–204
c-*fos* gene expression, 201
clinical and pharmacological implications of multiple receptors, 204
DA receptor gene expression, 203
distribution, 198–200
function, 200–201
neuropeptide gene expression, 201–203
regulation of gene expression, 201–203
transgenic animal studies, 203–204
catecholamine release, 207–208
classification, 190–191
dopaminergic signal transduction and hypertension, 211–212
animal models, 212
human hypertension, 211–212
gene structure, 191–192
in kidney, 208–211
peripheral, 205–211
pharmacological properties, 194–195
in pituitary, 205
renin-angiotensin-aldosterone system control, 206–207
aldosterone production in, 206–207
receptors in adrenal cortex, 207
renin secretion, 206
signal transduction, 195–198
additional pathways involved in mitogenesis, 198
adenylyl cyclase, 195
arachidonic acid, 197
calcium channels, 195–196
Na^+/H^+ exchange, 197
Na^+-K^+-ATPase, 197–198
potassium channels, 196–197
structure, 192–193
variants, 193–194
D_2 receptor, 193
D_3 receptor, 193
D_4 receptor, 193–194
Drinking behavior
angiotensin-induced, 585–587
acetylcholine and, 638–639
in amphibians, 604
angiotensin analogs and antagonists, 611–620
angiotensin peptides formed from precursors in brain, 630–637
in birds, reptiles, and fish, 603–604
catecholamines and, 639–640
central nervous system and, 620–630
c-*fos* expression after, 621–622
endothelins and, 643
excitatory and inhibitory amino acids and, 640
importance of sodium, 604
natriuretic peptides and, 643–644
neurotransmitters and, 637–649
nitric oxide and, 646
opioids and, 642–643
in other mammals, 601–603
other neuroactive substances in, 646–647
oxytocin and, 644–645
prostaglandins and, 645–646
in rat, 593–600
serotonin and, 640
tachykinins/bombesin-like peptides and, 640–642
vasopressin and, 644
drug-induced hyperreninemia and, 649–658
β-adrenergic agents, 649–650
angiotensin-converting enzyme inhibitors, 651–655
furosemide, 650–651
histamine, 655
insulin, 656–657
3,4-methylenedioxymethamphetamine, 656
serotonin, 656
hypovolemic thirst and sodium appetite, 587–589
renin-dependent
adrenal insufficiency and, 660–661
circulatory shock and, 661
diabetes insipidus and Brattleboro rat, 665–666
diabetes mellitus, 666–667
experimental and clinical causes, 658–667
experimental renal hypertension and, 661–664
heart failure and, 659
hyperoncotic dialysis and, 659–660
kidney disease and hyperreninemia, 664–665
obstruction of inferior vena cava and, 658–659
ureteric ligation, 665
***Drosophila* spp.**
genetics, free radical theory of aging, 566
transgenic, free radical theory of aging, 568

E

Eicosanoids, in cell volume regulation, 257–258
Electrostatic forces, stabilization of A-band lattice in striated muscle, 377–378
Embryogenesis
1α,25-dihydroxyvitamin D_3 in, 1214
neuronal differentiation. *See* Neuronal differentiation
Endocytosis
hepatocyte, cytoplasmic dynein and receptor-mediated, microtubule-dependent vesicle transport, 1117
microtubule-dependent vesicle transport and, 1112–1113
Endothelin(s)
angiotensin-induced drinking and, 643
calcium signaling in glial cells, 120–121
cerebral circulation regulation, 60–61
in subarachnoid hemorrhage, 72

Endothelium, regulation of cationic amino acid transport, 536–537
Endothelium-derived constricting factor, cerebral circulation regulation, 62
Endothelium-derived hyperpolarizing factor, cerebral circulation regulation, 59–60
Endothelium-derived vasoactive factors
carbon monoxide, 62
endothelin, 60–61
endothelium-derived constricting factor, 62
endothelium-derived hyperpolarizing factor, 59–60
nitric oxide, 55–58
prostacyclin, 58–59
reactive oxygen species, 61–62
regulation of cerebral circulation, 55–62
Energy metabolism, in short-term myocardial hibernation, 1063–1064
Epithelial transport
cell volume regulation and, 264–265
in polycystic kidney disease, 1165–1186
Erythrocyte function, cell volume regulation and, 264
Esophagus, smooth muscle cells
heterogeneous distribution of receptors, especially on nitrergic receptors, 834
nerve plexuses, nerve terminals, varicosities, and cotransmitters, 824–825
Ethanol consumption, microtubule-dependent vesicle transport and, 1118–1119

F

Fatty acids, short-chain, absorption, gut microbes, 410–415
Feminization, testicular, androgen receptor defects and, 18–19
Fermentation
carbohydrate, gut microbes, 410–415
microbial, associated diseases, 418–419
Fertilization, ion channel changes, 314–315
Filament lattice, 359–385
A-band lattice
backbone, 364
density across, 362–364
forces stabilizing, 377–384
cross-bridge forces, 380–383
electrostatic forces, 377–378
entropic forces, 380
extracellular structural components, 380
intrafibrillar structural forces, 380
ionic strength and, 379
pH effects, 378–379
radial forces in A band, 383–384
Van der Waals forces, 379–380
structure, 361–365
X-ray diffraction from, 361–362
A-band lattice of intact muscle, 365–369
changes with osmotic shrinking or swelling, 366–367
changes with sarcomere length, 366
contractile force as function of lattice spacing, 372–374
effect of length changes during contraction, 369
intensity changes during contraction, 368
lattice spacings, 365–366
spacing changes during contraction, 367–368
A-band lattice of skinned muscle, 369–372
changes in lattice spacing with physiological state, 372
changes in sarcomere length and, 371
contractile force as function of lattice spacing, 374–375
control of lattice dimensions by osmotic agents, 370–371
filament charges, 371–372
preparation of skinned muscle fibers, 369–370
contractile force as function of spacing, 372–375
intact muscle and fibers, 372–374
skinned muscle fibers, 374–375
lattice effects in other striated muscles, 375–377
invertebrate heart muscle, 376–377
vertebrate heart muscle, 375–376
spacing, contractile force as function of, 372–375
Z-line and I-band lattice structure, 364–365
Fish
angiotensin-induced water intake, 603
nutrition, diet, habitat, and digestive system characteristics, 394–395
Free radical theory of aging, 547–572
administration of pharmacological antioxidants, 564
antioxidant defenses, 553–554
classical and population genetics, 565–567
Caenorhabditis elegans, 565–566
Drosophila spp., 566
rodent species, 567
dietary restriction, 562–563
inherited degenerative diseases, 569
interaction of oxidant generation, damage, and repair, 554
interspecies comparisons, 561–562
antioxidant defenses and maximum life-span potential, 561–562
generation of reactive oxygen species and maximum life-span potential, 562
oxidative damage and maximum life-span potential, 561
in vitro senescence and oxidants, 564–565
manipulation of oxygen tension, 563
manipulation of rate of living, 563
molecular genetics, 567–568
oxidants and mitochondrial somatic mutations, 567–568
oxidants and nuclear somatic mutations, 567
origins, 549
overview, 549–554
oxidants and evolutionary theories of aging, 554–555
oxidants and mitochondrial theories of aging, 556
oxidants and somatic mutation theory of aging, 555–556
oxidative phenomenology: age-associated trends, 556–561

accumulation of oxidative end products, 556–557
antioxidant defenses and repair, 559–560
oxidant generation, 560–561
oxidative depletion of biochemical pools, 559
steady-state levels of oxidative modification, 557–559
refinements and corollaries, 554–556
repair of oxidative damage, 554
sources of oxidants, 549–552
sporadic degenerative diseases, 569
supplementation with dietary antioxidants, 563–564
targets of oxidants, 552–553
transgenic organisms, 568–569
Drosophila, 568
mice, 568–569
Furosemide, hyperreninemia, drinking behavior and, 650–651

G

Gap junctions, developmental regulation of ion channel expression, 327–329
Gastrointestinal hormones
biology, 1087–1102
classic concept, 1088–1089
new concepts, 1089–1100
cell-specific peptide release, 1100
cell-specific prohormone processing, 1099
many hormones and their families, 1089–1092
multiple phenotypes of hormone gene, 1092–1097
perspective, 1101
widespread gene expression, 1097–1099
Gastrointestinal tract
foregut
carbohydrate fermentation, 411–412
characteristics and distribution of indigenous microbes, 408
production of microbial protein and recycling of nitrogen, 416
hindgut
carbohydrate fermentation, 412–413
characteristics and distribution of indigenous microbes, 409–410
production of microbial protein and recycling of nitrogen, 416–417
microbial flora. *See* Gut microbes
midgut
carbohydrate fermentation, 412
characteristics and distribution of indigenous microbes, 408–409
mutual relationship between nitric oxide and vasoactive intestinal polypeptide, 836–838
ruminant forestomach
carbohydrate fermentation, 410–411
characteristics and distribution of indigenous microbes, 408
production of microbial protein and recycling of nitrogen, 415–416
smooth muscle cells
heterogeneous distribution of receptors, especially on nitrergic receptors, 833–834
muscarinic receptors, 830
nerve plexuses, nerve terminals, varicosities, and cotransmitters, 823–824
purinoceptors, 832–833
Genes/genetics
adenosine 5′-triphosphate-sensitive potassium channel genes, 228–231
$K_{IR}6.x$ genes, 228–231
sulfonylurea receptor genes, 228–231
autosomal dominant polycystic kidney disease, 1166–1167
in cell volume regulation, 259
c-*fos* expression after angiotensin-induced drinking, 621–622
free radical theory of aging, 565–567
molecular genetics, 567–568
gastrointestinal hormones, 1092–1099
gene expression in brain, dopamine receptors and, 201–203
gene structure of dopamine receptors, 191–192
G protein-coupled receptors, 37–44
antisense techniques, 39–41
gene targeting studies, 41–44
receptor knockout techniques, 41–44
transgenic techniques, 37–39
peroxisomal protein import and biogenesis, 173–174
PEX genes, 174
phospholamban gene structure, expression, and regulation, 928–930
sex-determining gene *SRY*, 3–5
SOX genes and functions, 8–9
vitamin D-dependent genes, 1209–1210
Genetic disorders
cationic amino acid transport, 533–535
plasma membrane amino acid transport, 1032–1038
Glial cells
calcium in
brain pathology and, 129–130
Ca^{2+}-permeable channels, 103
Ca^{2+} storage organelles, intracellular release, and store-operated channels, 103–105
Ca^{2+} transporters, 105
experimental approaches to measurement, 102
intracellular Ca^{2+} sensors and effectors, 105–106
overview of homeostasis, 102–106
resting intracellular calcium, 102–103
calcium signaling
glial function and, 130
glutamate-induced, 109–115
neuron-glial interactions and, 128–129
neurotransmitter-induced, 109–125
acetylcholine, 119
γ-aminobutyric acid, 118–119

bradykinin, 120
endothelins, 120–121
glutamate, 109–115
heterogeneity of neurotransmitter receptor expression in glial cells, 124–125
histamine, 119
monoamines, 117–118
other agonists, 121–124
purines and pyrimidines, 115–117
substance P, 120
purine- and pyrimidine-induced, 115–117
spatiotemporal organization of calcium signals, 125–128
intercellular Ca^{2+} waves, 127–128
intracellular Ca^{2+} oscillations, 125–127
voltage-gated Ca channels and depolarization-induced signals, 106–109
types, 100–102
voltage-gated Ca channels and depolarization-induced signals, 106–109
astrocytes, 106–107
mechanisms of glial cell depolarization, 109
oligodendrocytes, 107–109
Schwann cells, 106

Glomerular filtration rate, regulation by mesangial cells, 724–726

Glomerular mesangial cells, 723–737
diabetic models, 734–736
ion channels in, 736
mesangial tone in, 735
glomerular filtration rate regulation, 724–726
hormonal actions, 726–728
contracting hormones, 726–727
relaxing hormones, 727–728
ion-selective channels of plasmalemmal membrane, 728–730
calcium channels, 729
chloride channels, 728–729
nonselective cation channels, 729
potassium channels, 729–730
physiological roles, 724
regulation of mesangial contraction, 730–731
ion channels in, 731
signal transduction pathways, 730
regulation of mesangial relaxation, 731–734
BK_{Ca} channels in, 733–734
cAMP signaling, 731–732
cGMP signaling, 732–733

Glomerulus
mesangial-capillary unit, 725–726
ultrastructure and function, 724–725

Glucagon-like peptide, angiotensin-induced drinking and, 647

Glutamate, calcium signaling in glial cells, 109–115
astrocytes, 111–114
oligodendrocytes, 114–115
Schwann cells, 111

Glycerophosphorylcholine, cell volume regulation, 251

Glycine, calcium signaling in glial cells, 118–119

Glycolytic enzymes, cytoskeletal activity, 764–765

Gonadal dysgenesis, 46, XY, 5

G protein(s)
in cell volume regulation, 255–256
G_{olf}, cAMP-mediated signaling in olfactory cells, 442
G protein-coupled cation channels, visceral smooth muscle cells, 859–869

G protein-coupled receptors, 35–47
β_1-adrenoceptors, 45–46
α_2-adrenoceptors, 45
endothelin receptor, 44–45
function, 44–47
functional and mechanistic insights through altered gene expression, 35–47
adapting physiological techniques to the mouse, 47
function: illustrative examples, 44–47
genetic approaches to study, 37–44
genetic studies, 37–44
antisense techniques, 39–41
gene-targeting techniques, 41–44
receptor knockout techniques, 41–44
transgenic techniques, 37–39
signaling, modification of genes associated with, 46–47
thrombin receptor, 45

Gradient cyst, renal, 1181–1183

Growth and development, somatotropin in, 747–748

Guanosine 3′,5′-cyclic monophosphate (cGMP)
effects of melatonin signal transduction, 702
glomerular mesangial relaxation, 732–733

Guanosine triphosphatases, cytoskeletal activity, 767–768

Gut microbes
absorption of short-chain fatty acids, 413–415
contributions to energy requirements, 414–415
contribution to sodium and water absorption, 415
mechanisms, 413–414
carbohydrate fermentation, 410–415
absorption of short-chain fatty acids, 413–415
digestive tract of other species, 411–413
ruminant forestomach, 410–411
characteristics and distribution, 408–410
foregut of other species, 408
hindgut, 409–410
midgut, 408–409
ruminant forestomach, 408
in detoxification, 418
fermentation and disease, 418–419
production and conservation of nutrients, 393–400
carbohydrate fermentation, 410–415
digesta passage and retention time, 403–408
production and absorption of vitamins, 417–418
production of microbial protein and recycling of nitrogen, 415–417
variations in diet, habitat, and digestive system characteristics of vertebrates, 394–403

H

Hartnup disease, 1036–1037
Heart failure
phospholamban expression, 939–940
renin-dependent drinking, 659
Heat loss, 343–345
insulative properties of body fat and aging, 344–345
vasoconstriction, heat loss, and aging, 343–344
Heat shock proteins
HSP40, in import of peroxisomal targeting signal 1-containing proteins, 176
HSP70, in import of peroxisomal targeting signal 1-containing proteins, 176
Hepatic cysts, in autosomal dominant polycystic kidney disease, 1183
Hepatocytes
autophagic, peroxisomal, and lysosomal trafficking pathways, microtubule-dependent vesicle transport and, 1117–1118
cytoplasmic dynein and receptor-mediated endocytosis, microtubule-dependent vesicle transport, 1117
transcytosis, microtubule-dependent vesicle transport, 1116–1117
Hermaphroditism, 46, XX, 5–6
Hibernating myocardium. *See* Myocardial hibernation
Histamine
angiotensin-induced drinking and, 647
calcium signaling in glial cells, 119
hyperreninemia, drinking behavior and, 655–656
Hormone(s)
adipocyte differentiation, 791–795
gastrointestinal, 1087–1102
glomerular mesangial cells, 726–728
release of, cell volume regulation and, 267–268
Hypercapnia, cerebral circulation and, 55
Hypercholesterolemia, cerebral circulation and, 70–71
Hyperoncotic dialysis, renin-dependent drinking, 659–660
Hyperreninemia
drug-induced, drinking behavior and, 649–658
renin-dependent drinking, 664–665
Hypertension
acute, cerebral circulation and, 68–69
cerebral circulation and, 68–70
chronic, cerebral circulation and, 69–70
dopaminergic signal transduction and, 211–212
renal, renin-dependent drinking, 661–664
Hypovolemia
detection, and threshold of response, 589–590
thirst and sodium appetite, 589–593
angiotensins in, 593
arousal of sodium appetite, 590–592
causes of hypovolemic thirst, 589
detection of hypovolemia and threshold of response, 589–590
renal renin-angiotensin system in, 592–593
Hypoxia, cerebral circulation and, 55

I

Iminoglycinuria, 1037–1038
Immune system
cationic amino acid transporters in, 535–536
1α,25-dihydroxyvitamin D_3 in, 1213
Inferior vena cava, obstruction, renin-dependent drinking, 658–659
Inositol, cell volume regulation, 252
Inositol trisphosphate, signaling in olfactory cells, 446–450
Inotropic reserve, in myocardial hibernation
chronic, 1074
short-term, 1064
Insulin, hyperreninemia, drinking behavior and, 656–657
Intestines, cationic amino acid transport in, 529–531
Ion(s)
cell volume regulation, 251–252
in nasal mucus, 453–454
strength, effect on lattice of striated muscle, 379
Ion channels
calcium channel development, 325–326
changes during oogenesis and fertilization, 314–317
cytoskeleton and cell signaling, 768–771
developmental regulation of expression, 327–330
changes in gap junctional communication, 327–329
transcription in, 329–330
early changes, 317–319
Cl^- and other ion channels, 318–319
cleavage, blastula, and animal-vegetal axis, 317
egg-type Na^+ and Ca^{2+} channels, 317–318
K^+ channels, 318
glomerular mesangial plasmalemmal membrane, 728–730
role in mesangial contraction, 731
neuronal differentiation, 307–330
during oocyte maturation, fertilization, and cytoplasmic movement, 314–315
in oocytes, 315–317
potassium. *See* Potassium channels
Iris, muscarinic receptors, 830–831
Ischemia
cerebral circulation and, 72
myocardial. *See* Myocardial ischemia
Ischemia-reperfusion injury, renal, microtubule-dependent vesicle transport and, 1125

K

Kidney
cationic amino acid transport in, 531–532
dopamine receptors, 208–211
Kidney disease
hyperreninemia, renin-dependent drinking, 664–665

ischemia-reperfusion injury, microtubule-dependent vesicle transport and, 1125
microtubule-dependent vesicle transport and, 1124–1125
polycystic, 1165–1186
microtubule-dependent vesicle transport and, 1124–1125
Kidney function, microtubule-dependent vesicle transport and, 1119–1124
Knockout mice, generation of, 1138–1141
gene knockout through gene targeting, 1138–1140
inducible and tissue-specific knockouts, 1140–1141

L

Lactation, somatotropin in, 748–750
Learning, transgenic animal study, 1148–1151
Leukocyte chemotaxis. ***See*** **Chemotaxis**
Life span, maximum potential
antioxidant defenses and, 561–562
oxidative damage and, 561
reactive oxygen secies generation and, 562
Light adaptation, melatonin in, 689–690
Lipid kinases, cytoskeletal activity, 766
Lipid metabolism, shivering thermogenesis and aging, 347
Lipogenesis, somatotropin and, 751–754
Lipolysis, somatotropin and, 751–754
Liver disease, microtubule-dependent vesicle transport and, 1118–1119
Liver function, microtubule-dependent vesicle transport and, 1113–1118
Locomotion, transgenic animal study, 1147–1148
Lysinuric protein intolerance, 534–535, 1035–1036

M

Macrophages, regulation of cationic amino acid transport, 538
Magnesium, in cell volume regulation, 257
Mammals, nutrition, diet, habitat, and digestive system characteristics, 398–403
Mammary glands, metabolism, somatotropin and, 755–756
Mechanical stress, cytoskeleton and, 771–772
Melanophore
amphibian, melatonin transduction, 695
dermal, light adaptation, melatonin in, 689
Melatonin
cellular mechanisms of action, 687–711
endocrine effects, 689–692
light adaptation in dermal melanophores, 689
light adaptation in retina, 689–690
photoperiod and, 688–689
modeling photoperiodic signal in vitro, 710–711
regulation of seasonal rhythms, 690–692
hypothetical mechanisms, 709–710
signal transduction
amphibian melanophores, 695
in caudal artery, 699
effects on cAMP, 701–702
effects on cGMP, 702
effects on intracellular calcium, 703–705
hypothetical mechanisms, 705–708
effects on phospholipids, 702–703
effects on third messengers, 708–709
in vitro models, 695–700
in neonatal rat gonadotroph, 696–697
in pars tuberalis, 696
in retina, 695–696
in suprachiasmatic nucleus, 697–699
in transfected cells, 699–700
synchronization of circadian rhythm, 690
synthesis, daily rhythm and modulation by photoperiod, 688–689
Melatonin receptors, 692–694
characterization, 693
density, regulation of, 694
distribution, 692–693
Memory, transgenic animal study, 1148–1151
Meningitis, cerebral circulation in, 73–74
Metabolism
in myocardial hibernation
chronic, 1073–1074
short-term, 1062–1064
regulation of, cell volume regulation and, 266–267
3,4-Methylenedioxymethamphetamine, hyperreninemia, drinking behavior and, 656
Microglia, purine- and pyrimidine-induced calcium signaling, 116
Microtubule-dependent vesicle transport, 1109–1125
cytoplasmic microtubule-based motors, 1111–1112
endocytosis and transcytosis and, 1112–1113
ischemia-reperfusion injury of kidney and, 1125
liver disease and, 1118–1119
liver function and, 1113–1118
autophagic, peroxisomal, and lysosomal trafficking pathways in hepatocytes, 1117–1118
bile salt transportation and secretion, 1113–1115
cytoplasmic dynein and receptor-mediated endocytosis in hepatocytes, 1117
electrolyte/fluid secretion at canaliculus, 1115–1116
future challenges, 1118
hepatocyte transcytosis, 1116–1117
microtubule organization, 1110–1111
polycystic kidney disease and, 1124–1125
renal function and, 1119–1124
apical endocytosis, 1121–1122
basolateral localization of transporters, 1122–1123
future questions, 1123–1124
maintenance of apical water and ion channels in renal epithelia, 1119–1121
transepithelial transport of organic ions, 1122

Microtubules
in cell volume regulation, 254
peroxisome movement in mammalian cells, 183–184
Mitosis, peroxisome inheritance during, 183
Molecular genetics, free radical theory of aging, 567–568
Monoamines, calcium signaling in glial cells, 117–118
Mucus, nasal, ionic concentrations and ion homeostasis, 453–454
Muscarinic receptors, in visceral smooth muscle cells, 829–831
Myelin, calcium signaling in glial cells, 124
Myocardial hibernation, 1055–1079
acute ischemia, 1057–1059
chronic, 1070–1077
clinical scenarios, 1070–1071
coronary reserve and inotropic reserve in, 1074
diagnosis, 1076–1077
metabolism in, 1073–1074
morphology, 1074–1076
relation of flow and function, 1071–1073
therapy, 1077
concept and its evolution, 1055–1057
conclusions and perspectives, 1077–1079
short-term, 1059–1070
adenosine in, 1066–1067
ATP-dependent K channels in, 1066
calcium transient in, 1067–1068
energy metabolism in, 1063–1064
events triggering, 1068–1069
inotropic and coronary reserve in, 1064–1066
ischemic preconditioning vs., 1069
limits, 1066
mechanisms, 1066–1068
metabolism in, 1062–1064
morphology, 1069–1070
recovery of function after, 1062
relation of flow and function during, 1059–1062
stunning vs., 1069
substrate metabolism in, 1062–1063
Myocardial ischemia, acute, 1057–1059
contractile dysfunction in, 1057
mechanisms, 1058–1059
relation of flow and function during, 1057–1058

N

Natriuretic peptides, angiotensin-induced drinking and, 643–644
Neuronal differentiation, 307–330
calcium channel development, 325–326
ion channels, 308–309
changes during oogenesis and fertilization, 314–317
developmental regulation of expression, 327–330
development of ion channels other than sodium, 325–327
comparison with other vertebrate species embryos, 326–327
early changes, 317–319
K^+ and Ca^{2+}, 325–326
potassium channel development, 325–326
neural commitment and changes in expression of ion channels, 320–325
inducer candidates for Na^+ spike induction, 324–325
neural induction in vertebrate embryos, 320
quantitative difference in expression of K_{IR} channels as early sign of neural induction, 322–324
TuNa I channels—neuron-specific markers expressed after inductive differentiation, 321–322
two-cell induction system constructed from ascidian embryos, 320–321
protochordate embryo, 309–314
Neuropeptide Y
angiotensin-induced drinking and, 647
calcium signaling in glial cells, 122
Neurotensin, angiotensin-induced drinking and, 647
Neurotransmitters
angiotensin-induced drinking and, 637–649
calcium signaling in glial cells, 109–125
Nitric oxide
aging and, 571
angiotensin-induced drinking and, 645–646
cerebral circulation regulation, 55–58
mutual relationship between nitric oxide and vasoactive intestinal polypeptide in visceral smooth muscle cells, 836–838
in olfactory neurons, 452
in visceral smooth muscle cells, 833–835
Nitric oxide synthase(s)
cerebral circulation regulation, 55–57
endothelial NOS gene expression, 58
in endothelium, 57–58
inducible, cerebral circulation regulation, 62–64
Nitrogen
metabolism, cationic amino acid transport, 527
recycling, gut microbes in, 415–417
Nutrition
cationic amino acid transport, 527–528
contributions of gut microbes, 393–420
carbohydrate fermentation, 410–415
characteristics and distribution of indigenous gut microbes, 408–410
digesta passage and retention time, 403–408
microbial detoxification, 418
production of microbial protein and recycling of nitrogen, 415–417
variations in diet, habitat, and digestive system characteristics, 394–403
vitamin production and absorption, 417–418
free radical theory of aging
dietary manipulation, 562–563
supplementation with dietary antioxidants, 563–564

variations in diet, habitat, and digestive system characteristics, 394–403
amphibians, 395–396
birds, 397–398
fish, 394–395
mammals, 398–403
reptiles, 396–397
Nutritional epidemiology, oxidants and antioxidants, 569–570

O

Olfactory receptor neurons, 429–458
cAMP-mediated signaling, 442–446
calcium-activated chloride current, 445–446
olfactory cyclic nucleotide-gated conductance, 442–445
olfatory receptors, G_{olf}, and cAMP formation, 442
capacitance and resting membrane resistance, 432
conductances involved in action potential generation, 434–436
potassium conductances, 435–436
voltage-gated calcium currents, 435
voltage-gated sodium currents, 434–435
geometry, 430–432
$InsP_3$-mediated signaling, 446–450
electrophysiological studies, 449–450
inositol polyphosphate-regulated conductance(s), 447–449
$InsP_3$ formation and receptors, 446–447
membrane time constant, 433
odorant responses, 436–442
diversity of transduction mechanisms, 439–441
inhibitory responses, 439–440
intracellular calcium responses, 439
odorant-gated channels, 441
odorant-induced "cation" current, 437–438
optical recordings, 438–439
ORN modulation by autonomic nervous system, 440–441
recording methods, 436–437
responses of olfactory neurons in culture, 441
responses of vomeronasal neurons, 441–442
passive membrane properties, 432–434
resting membrane potential, 432–433
sensitivity and single odorant molecule detection, 433–434
signal transduction
calcium as third messenger in, 450–452
cAMP-mediated signaling, 442–446
conductances involved in action potential generation, 434–436
gaseous messengers in olfactory neurons, 452–453
$InsP_3$-mediated signaling, 446–450
ionic concentrations in mucus and ion homeostasis, 453–454
multiple second messenger pathways, 455–457
odorant responses, 436–442
summary and perspectives, 457–458
Oligodendrocytes
glutamate-induced calcium signaling, 114–115
purine- and pyrimidine-induced calcium signaling, 116
voltage-gated Ca channels and depolarization-induced signals, 107–109
Oocyte(s)
ion channels, 315–317
maturation, ion channel changes, 314–315
Oogenesis, ion channel changes, 314–317
Opioids
angiotensin-induced drinking and, 642–643
calcium signaling in glial cells, 123–124
Osmolytes, cell volume regulation, 251–252
Oxidants
aging and, 570–571. *See also* Free radical theory of aging
apoptosis and, 571
generation, age-associated trends, 560–561
in vitro senscence and, 564–565
mitochondrial somatic mutations, 567–568
nuclear somatic mutations, 567
nutritional epidemiology, 569–570
signal transduction, 571–572
sources, 549–552
targets of, 552–553
Oxygen tension, manipulation, free radical theory of aging, 563
Oxytocin
angiotensin-induced drinking and, 644–645
calcium signaling in glial cells, 122

P

Pacemaker potentials, visceral smooth muscle cells, 819–822
Pancreas, islet cells, 1α,25-dihydroxyvitamin D_3 in, 1213
Parathyroid gland
in calcium homeostasis, 1200–1201
1α,25-dihydroxyvitamin D_3 in, 1203, 1211
Parathyroid hormone, in calcium homeostasis, 1200–1201
Pars tuberalis, melatonin signal transduction, 696
Pathogen-host interaction, cell volume regulation and, 270–271
Perception, adult cortical dynamics, 467–481
anatomic basis of contextual effects, 470–472
attention and expectation, 479–480
contextual influences, 468–470
lesion-induced plasticity of sensory and motor maps, 472–474
perceptual learning, 476–479
short-term plasticity, 474–476
Perceptual learning, adult cortical dynamics, 476–479
Peroxisomes, 171–184
biochemical analysis of peroxisomal protein import, 174–176
matrix protein import, 174
membrane protein import, 175–176
biogenesis of peroxisomal membrane proteins, 179–180
constitutive and regulated division, 181
degradation by autophagy, 182–183

genetic analysis of peroxisomal protein import and biogenesis, 173–174
isolation of *pex* mutants, 174
PEX genes and the peroxins they encode, 174
human peroxisomal disorders, 180
PEX genes in, 180–181
protein import deficiencies in, 180
import of peroxisomal targeting signal 1-containing proteins, 176
HSP70 and HSP40 in, 176
peroxisomal docking proteins for PTS receptors, 178
PTS receptors, 176–178
matrix protein import
biochemical analysis, 174
pathways, 172–173
protein unfolding during, 178–179
targeting of matrix proteins, 172
membrane protein import
biochemical analysis, 175–176
pathways, 173
targeting of membrane proteins, 173
microtubule-dependent movement in mammalian cells, 183–184
mode of peroxisome inheritance during mitosis, 183
peroxisomal protein import pathways, 172–173
matrix protein import pathways, 172–173
matrix protein targeting, 172
membrane protein import pathways, 173
membrane protein targeting, 173
***PEX* genes, 174**
conservation, 180
in human disease, 180–181
pH
in acidic cellular compartments, in cell volume regulation, 258
cytosolic, in cell volume regulation, 255
lattice spacing in striated muscle, 378–379
Pharmacology, dopamine receptors, 194–195
Phospholamban, 921–940
calcium pump regulation in sarcoplasmic reticulum, 930–937
discovery of, 922
gene structure, expression, and regulation, 928–930
in human heart failure, 939–940
phosphorylation and function in intact systems, 937–939
purification and structure, 923–928
Phospholipases, cytoskeletal activity, 766
Phospholipids, effects of melatonin signal transduction, 702–703
Photoperiod
modeling photoperiodic signal in vitro, 710–711
modulation of daily rhythm of melatonin synthesis, 688–689
Pituitary adenylate cyclase activating polypeptide 38, angiotensin-induced drinking and, 647
Pituitary gland, dopamine receptors, 205
Placenta, cationic amino acid transport in, 532–533
Plateau potentials, visceral smooth muscle cells, 822
Platelet-activating factor
calcium signaling in glial cells, 122
leukocyte chemotaxis, 951
Platelet-derived growth factor, calcium signaling in glial cells, 123
Polycystic kidney disease
animal and cell models, 1168–1169
autosomal dominant polycystic kidney disease tissue, 1176–1181
Madin-Darby canine kidney cell model, 1174–1176
transport mechanisms involved in fluid secretion, 1174–1181
cyst-activating factor in cyst fluid, 1183–1184
cyst fluid, 1171–1172
composition, 1171
cyst-activating factor in, 1183–1184
exchange with circulation, 1171–1172
cyst growth, 1172–1174
cyst formation by cultured cells, 1173–1174
in vivo, 1172–1173
cystic cell vs. other epithelial cells, 1185–1186
intestinal crypt and lung cells, 1185–1186
renal epithelial cells, 1185
epithelial transport in, 1165–1186
fluid absorption by cystic epithelium, 1181
functional abnormalities, 1169–1171
genetic factors, 1166–1167
gradient cyst, 1181–1183
hepatic cysts in, 1183
microtubule-dependent vesicle transport and, 1124–1125
morphology, 1167–1168
questions remaining, 1184–1185
transport mechanisms involved in fluid secretion, 1174–1181
autosomal dominant polycystic kidney disease tissue, 1176–1181
Madin-Darby canine kidney cell model, 1174–1176
Potassium channels
ATP-dependent (sensitive). *See* Potassum channels, K_{ATP}
calcium-dependent, in cerebral circulation regulation, 66–67
in cerebral circulation regulation, 64–68
development, 325–326
egg-type, 318
glomerular mesangial plasmalemmal membrane, 729–730
inwardly rectifying (K_{IR}), 232–233
in cerebral circulation regulation, 67–68
inwardly rectifying channel 6 ($K_{IR}6x$) genes, 231
K_{ATP}, 227–242
adenosine 5′-triphosphate binding cassette protein family, 231–232
affinities of SUR 1 and SUR 2 for sulfonylureas, 233–234
are sulfonylurea receptors promiscuous, 236
cardiac- and smooth muscle-type, 235–236
β-cell-type, 234–235, 240–241
in cerebral circulation regulation, 65–66
coexpression of SUR 1 and $K_{IR}6.2$
generation of β-cell-type K_{ATP} channel, 234–235
glycosylation state of receptor and, 236–237
coexpression of SUR 2 and $K_{IR}6.2$, 235–236

complex glycosylated 950-kilodalton complex, 241
fusion of SUR 1 and $K_{IR}6.2$, 238–240
genes, 228–231
inwardly rectifying family, 232–233
$K_{IR}6.2$ and β-cell K_{ATP} pore, 240–241
$K_{IR}6.x$ genes, 231
model and conclusions, 242
physical association of SUR 1 and $K_{IR}6.2$ subunits, 237–238
in short-term myocardial hibernation, 1066
sulfonylurea receptor (SUR) genes, 228–231
in oocytes, 315–317
signal transduction of dopamine receptors, 196–197
in subarachnoid hemorrhage, 72
in visceral smooth muscle cells, 839–846
voltage-dependent, in cerebral circulation regulation, 67
Potassium currents
muscarinic receptor-inactivated (M current), visceral smooth muscle cells, 870–871
voltage-gated, action potential generation in olfactory neurons, 435–436
Pref-1, adipocyte differentiation, 795–797
Prostacyclin, cerebral circulation regulation, 58–59
Prostaglandins, angiotensin-induced drinking and, 645–646
Prostanoids, calcium signaling in glial cells, 122–123
Protein kinases, cytoskeletal activity, 765–766
Protein metabolism, somatotropin and, 755
Protein phosphorylation, in cell volume regulation, 256–257
Protein synthesis, cationic amino acid transport, 527
Protochordate embryo, 309–314
cell lineage of ascidian embryos, 310–312
development of excitability in cleavage-arrested embryos, 312–314
prototype of vertebrate embryos, 309–310
Purines, calcium signaling in glial cells, 115–117
Purinoceptors, in visceral smooth muscle cells, 831–833
purinoceptor-coupled ion channels, 853–859
Pyrimidines, calcium signaling in glial cells, 115–117

R

Rate of living, manipulation, free radical theory of aging, 563
Reactive oxygen species, cerebral circulation regulation, 61–62
Receptive field properties, adult cortical dynamics, 467–481
5α-Reductase, defects, intersex phenotype, 19
Reinforcement behavior, transgenic animal study, 1151–1152
Relaxation, glomerular mesangial cells, 731–734
Renal hypertension, renin-dependent drinking, 661–664
Renin
in drinking behavior, 617
secretion, dopamine receptors and, 206
Renin-angiotensin-aldosterone system, regulation, dopamine receptors in, 206–207
Renin-angiotensin system, 587–589
in hypovolemia-induced drinking behavior, 592–593
Reproduction, 1α,25-dihydroxyvitamin D_3 in, 1213–1214
Reptiles
angiotensin-induced water intake, 603
nutrition, diet, habitat, and digestive system characteristics, 396–397
Retina
light adaptation, melatonin in, 689–690
melatonin signal transduction, 695–696
Retinoid X receptors, molecular mechanism of vitamin D action at target cells, 1207–1209
Retrograde signaling, 143–162. *See also* Synaptic transmission
Rodent species. *See also* Trangenic animal models
angiotensin-induced water intake (rat), 593–600
free radical theory of aging, 567–569
knockout mice, 1138–1141

S

Sarcoplasmic reticulum, calcium pump regulation, phospholamban and, 930–937
Schwann cells
glutamate-induced calcium signaling, 111
purine- and pyrimidine-induced calcium signaling, 115
voltage-gated Ca channels and depolarization-induced signals, 106
Seasonal rhythms, regulation, melatonin in, 690, 709–710
Serotonin
angiotensin-induced drinking and, 640
calcium signaling in glial cells, 121–122
hyperreninemia, drinking behavior and, 656
Serum albumin, calcium signaling in glial cells, 123
Sex steroids, in sexual differentiation, 17–18
Sexual differentiation, 1–21
androgens and sex steroids in, 17–18
autosomal and X-linked genes in, 15–21
biochemical activities of *SRY*, 6–15
defects in androgen receptor and testicular feminization, 18–19
defects in steroid biosynthesis, intersex phenotype, and congenital adrenal hyperplasia, 18
defects in steroid 5α-reductase and intersex phenotype, 19
MIS and sex differentiation, 16–17
mutation of MIS type II receptor and MIS receptor signal transduction, 17
role of human Y chromosome, 2–3
sex-determining gene *SRY*, 3–5. *See also SRY* gene
SRY transcription unit, 15
tissue-specific markers of testicular differentiation, 21
Signal transduction
adipocyte differentiation, 791–795
in brown adipose tissue, 351–352
calcium signaling in glia, 99–131
cytoskeleton and cell signaling, 763–775
dopamine receptors, 195–198

dopaminergic, hypertension and, 211–212
G protein-coupled receptors, modification of genes associated with, 46–47
melatonin, 700–709
in vitro models, 695–700
mesangial contraction, 730
mesangial relaxation, 731–734
regulatory roles for oxidants and antioxidants, 571–572
retrograde signaling and synapses, 143–162. *See also* Synaptic transmission
vertebrate olfactory receptor neurons, 429–458
Skeletal muscle
contraction, A-band lattice effects, 367–369
filament lattice of striated muscle, 359–385
shivering thermogenesis and aging, 345–347
smooth muscle, K_{ATP} channels, 235–236
Skin, 1α,25-dihydroxyvitamin D_3 in, 1213
Smooth muscle
K_{ATP} channels, 235–236
regulation of cationic amino acid transport, 537–538
visceral smooth muscle cells, 811–890
Sodium, in angiotensin-induced thirst, 604
Sodium appetite
of adrenal insufficiency, renin-dependent drinking, 660–661
angiotensin-induced, 605–611
arousal of, 590–592
hypovolemic, 587–589
Sodium channels
egg-type, 317–318
in oocytes, 315–317
in visceral smooth muscle cells, 846–848
Sodium currents, voltage-gated, action potential generation in olfactory neurons, 434–435
Sodium/hydrogen exchange, signal transduction of dopamine receptors, 197
Somatotropin, 745–757
efficacy, 747–750
in growth, 747–748
in lactation, 748–750
mechanisms of action, 750–756
effects on carbohydrate metabolism, 754–755
effects on lipogenesis and lipolysis, 751–754
effects on mammary gland metabolism, 755–756
effects on protein metabolism, 755
structure, 746–747
Sorbitol, cell volume regulation, 251
***SOX* genes, 8–9**
Spike potentials, visceral smooth muscle cells, 817–819
***SRY* gene, 3–5**
biochemical activities, 6–15
additional factors involved in regulation of MIS promoter, 14
factors involved in MIS regulation, 9–10
functional mapping of MIS promoter response to *SRY*, 13–14
mutated *SRY* from sex-reversed patients and MIS activation, 10–13
SOX gene and functions, 8–9
superactivator *SRY* isoleucine 68 phenylalanine, 13
expression, regulation, 15
mutations, 46, XY pure gonadal dysgenesis, 5
transcription unit, 15
translocation to X chromosome, 46, XX true hermaphroditism, 5–6
Steroidogenesis, defects, intersex phenotype and congenital adrenal hyperplasia, 18
Striated muscle, filament lattice, 359–385. *See also* Filament lattice
Stunning, short-term myocardial hibernation vs., 1067–1068
Subarachnoid hemorrhage
cerebral circulation and, 72–73
endothelin in, 72
endothelium-dependent relaxation in, 72
potassium channels in, 73
Substance P
calcium signaling in glial cells, 120
leukocyte chemotaxis, 951
Substrate metabolism, in short-term myocardial hibernation, 1062–1063
Sulfonylurea receptor (*SUR*) genes, 228–231
affinities of SUR 1 and SUR 2 for sulfonylureas, 233–234
Suprachiasmatic nucleus, melatonin signal transduction, 697–699
Synaptic transmission
activity-dependent retrograde synaptic modification, 148–152
synapse competition and elimination during development, 148–151
synaptic modification at mature synapses, 151–152
mechanisms of retrograde signaling, 152–156
signaling by membrane-bound factors, 155–156
signaling by membrane-permeant factors, 152–154
signaling by secreted factors, 154–155
presynaptic propagation of retrograde signals, 156–161
cytoskeleton-based axonal transport, 156–157
diffusional spread of cytosolic transduction cascades, 158–160
second messenger waves, 157–158
spread of synaptic modulation, 160–161
retrograde signaling at developing synapses, 144–148
early inductive events in synaptogenesis, 145–146
maturation of presynaptic structure and function, 146–148

T

Tachykinins, angiotensin-induced drinking and, 640–642
Taurine, cell volume regulation, 252
Testicular differentiation, tissue-specific markers, 21
Testicular feminization, androgen receptor defects and, 18–19
Thermogenesis

brown adipose tissue nonshivering thermogenesis and aging, 347–352
BAT mass, 348–350
GDP binding, 350
neural signaling and BAT thermogenic potential, 350–351
regulation of uncoupling protein production, 352
signal transduction in BAT, 351–352
uncoupling protein, 350
skeletal muscle shivering thermogenesis and aging, 345–347
carbohydrate metabolism in, 346–347
cellular metabolic capacity, 347
lipid metabolism in, 347
skeletal muscle mass, 345–346

Thermoregulation
cold-induced, 339–354. *See also* Age/aging
biological aging and, 341–354
rate of aging and, 352–353
heat loss, 343–345
insulative properties of body fat and aging, 344–345
vasoconstriction, heat loss, and aging, 343–344
heat production, 345–352
brown adipose tissue nonshivering thermogenesis and aging, 347–352
skeletal muscle shivering thermogenesis and aging, 345–347

Thirst
angiotensin-induced, 593–605
in amphibians, 604
importance of sodium, 604
water intake in birds, reptiles, and fish, 603–604
water intake in other mammals, 601–603
water intake in rat, 593–600
hypovolemic, 587–589

Thrombin, calcium signaling in glial cells, 123

Transcription, developmental regulation of ion channel expression, 329–330

Transcription factors, for adipocyte differentiation, 798–801
bHLH family, 800–801
C/EBP family, 799–800
PPAR family, 799

Transcytosis
hepatocyte, microtubule-dependent vesicle transport, 1116–1117
microtubule-dependent vesicle transport and, 1112–1113

Transgenic animal models
Alzheimer's disease, 1154–1155
amyotrophic lateral sclerosis, 1153–1154
dopamine receptor physiology in brain, 203–204
existing study paradigms, 1142–1152
behavioral tests, 1146–1152
learning and memory, 1148–1151
locomotion, 1147–1148
mouse models of human neurological and psychiatric disease, 1152–1155
neuronal excitability—ion channels, 1143–1145
physiological measures, 1143–1146
reinforcement, 1151–1152
vesicle fusion and neurotransmitter release, 1145–1146
free radical theory of aging, 568–569
generation of transgenic mice, 1133–1135
inducible expression of transgene, 1133–1135
mouse models of human neurological and psychiatric disease, 1152–1155
mutant mouse models
generation of, 1133–1141
mouse strain, 1141–1142
rationale for creation, 1132–1133

U

Ureter, ligation, renin-dependent drinking, 665

Urogenital organs
muscarinic receptors, 829–830
purinoceptors, 831–832
smooth muscle cells, heterogeneous distribution of receptors, especially on nitrergic receptors, 834–835

V

Van der Waals forces, effect on lattice of striated muscle, 379

Varicosities, visceral smooth muscle cells, 823–825
electrophysiological features, 825–827

Vasoactive intestinal polypeptide
calcium signaling in glial cells, 123
mutual relationship between nitric oxide and vasoactive intestinal polypeptide in visceral smooth muscle cells, 836–838

Vasoconstriction, heat loss and, biological aging and, 343–344

Vasodilatation, flow-mediated, cerebral circulation, 55

Vasopressin
angiotensin-induced drinking and, 644
calcium signaling in glial cells, 122

Visceral smooth muscle cells, 811–890
action potentials, 817–822
pacemaker potentials, 819–822
plateau potentials, 822
spike potentials, 817–819
calcium in
cytosolic, 871–873
factors decreasing, 882–884
factors increasing, 873–882
mobilization and maintenance of calcium homeostasis, 871–889
sensitization of smooth muscle contraction, 884–889
catecholamine receptors, 828–829
contraction, calcium sensitization, 884–889
cytosolic calcium concentration, 871–873
ion channels in VSMC membranes, 839–853
calcium channels, 848–852

chloride channels, 852–853
nonselective cation channels, 853
potassium channels, 839–846
receptor-operated ion channels, 853–871
sodium channels, 846–848
muscarinic receptors, 829–831
neural control of membrane activities, 822–839
airway, 825
calcitonin gene-related peptide in, 838–839
catecholamine receptors and related substances, 828–829
electrophysiological features of varicosities, 825–827
esophagus, 824–825
excitatory and inhibitory junction potentials, 827–833
gastrointestinal tract, 823–824
heterogeneous distributions of receptors, 833–835
multitransmitter release inferred from generation of excitatory and inhibitory junction potentials, 827–839
muscarinic receptors and related substances, 829–831
mutual relationship between nitric oxide and vasoactive intestinal polypeptide, 836–838
nerve plexuses, nerve terminals, varicosities, and cotransmitters, 823–825
purinoceptors and related substances, 831–833
relationship between nitric oxide-induced hyperpolarization and apamin, 835–836
receptor-operated ion channels, 853–871
cytosolic calcium-activated nonselective cation channels, 869–870
G protein-coupled cation channels, 859–869
muscarinic receptor-activated K^+ current (M current), 870–871
purinoceptor-coupled channels, 853–859
unclassified cation channels, 870
resting membrane potential and passive membrane properties, regional and species differences, 813–817
varicosities, electrophysiological features, 825–827

Visual system, adult cortical dynamics, 467–481
anatomic basis of contextual effects, 470–472
attention and expectation, 479–480
contextual influences, 468–470
lesion-induced plasticity of sensory and motor maps, 472–474
perceptual learning, 476–479
short-term plasticity, 474–476

Vitamin(s), production and absorption, gut microbes and, 417–418

Vitamin D, 1193–1222
analogs, 1214–1222
1α,25-dihydroxyvitamin D_3 analogs, 1214–1218
factors that alter action of, 1218–1222
future directions in drug design, 1222
in calcium homeostasis, 1200–1203
calcitonin in, 1201–1202
development of calcium homeostatic mechanisms, 1200
1α,25-dihydroxyvitamin D_3 regulation of parathyroid gland, 1203
intestinal calcium and phosphorus absorption, 1202
parathyroid gland and hormone in, 1200–1201
physiological actions of 1α,25-dihydroxyvitamin D_3, 1201
vitamin D and bone calcium mobilization, 1202–1203
vitamin D metabolites and other hormones in, 1202
1α,25-dihydroxyvitamin D_3
analogs, 1214–1218
in embryonic development, 1214
functions, 1210–1214
in immune system, 1212–1213
in islet cells of pancreas, 1213
new target organs, 1210
in parathyroid gland, 1203, 1211
in reproduction, 1213–1214
in skin, 1211–1212
metabolic activation, 1194–1200
hepatic 25-hydroxylation, 1196–1198
24-hydroxylation, 1199–1200
overview, 1194–1195
renal 1α-hydroxylation, 1198
molecular mechanism of action at target cells, 1203–1210
retinoid X receptors and other coactivators, 1207–1209
target cell metabolic enzymes, 1210
transcriptional regulation, 1203–1204
vitamin D-dependent genes, their roles, and complexity, 1209–1210
vitamin D receptors, 1205–1207
vitamin D responsive elements, 1209

Vitamin D receptors, molecular mechanism of vitamin D action at target cells, 1205–1207

Vomeronasal neurons, odorant responses, 441–442

W

Werner's syndrome, 569

Y

Y chromosome, sex-determining role, 2–3

Z

Zwitterionic amino acids, transport systems in plasma membrane, 970–972